Fossils C - Fossils - Camas C-Invite - 12-12-2020

1. You will have 50 mins to finish this test.

2. Each "station" should takes you 3-4 mins to complete.

3. You are expected to know everything listed in the official fossil list, every species/genus/order/class/phylum listed will be a possible question topic.

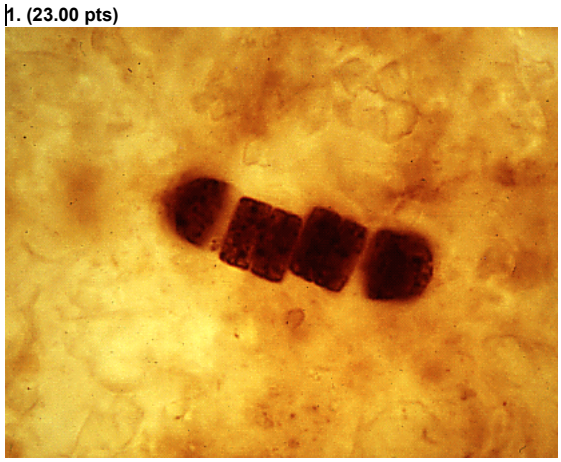
4. Unless the question specifies, please identify the specimens to the lowest classification on the official fossil list.

5. To prevent potential web issues, please only let one person (either you or your partner) to type answers in the answer box.

6. If you have any questions during the test, send private message to the event supervisors via the Scilympiad platform.

7. Q3#7, Q4#11, Q8#7 and Q6#12 are tiebreakers. If all tiebreakers are used and the ties still can't be broken, Q11's score will determines the team's rank.

1. (23.00 pts)



(A)

(B)

(C)

1. Identify one species from the official fossil list that contains A.

2. Identify one species from the official fossil list that contains B.

3. Identify one species from the official fossil list that contains C.

(Now let's call the species you identify from Q1 **X**, the species you identify from Q2 **Y**, and the species you identify from Q3 **Z**)

4. When did X first occur? What's its relationship with A (give its function as well)?

5. What is the main function of A? A are also divided into three main types. What are the names of these three main types?

6. List two dating methods that could be used to date A.

7. A is able to give X some toxicity. Please name the type of toxin that A could transfer.

8. When did Y first occur? What's its relationship with B (give its function as well)?

9. Name the type of B that Y has. How many types of B are there in total?

10. You could find Y on what type(s) of rock?

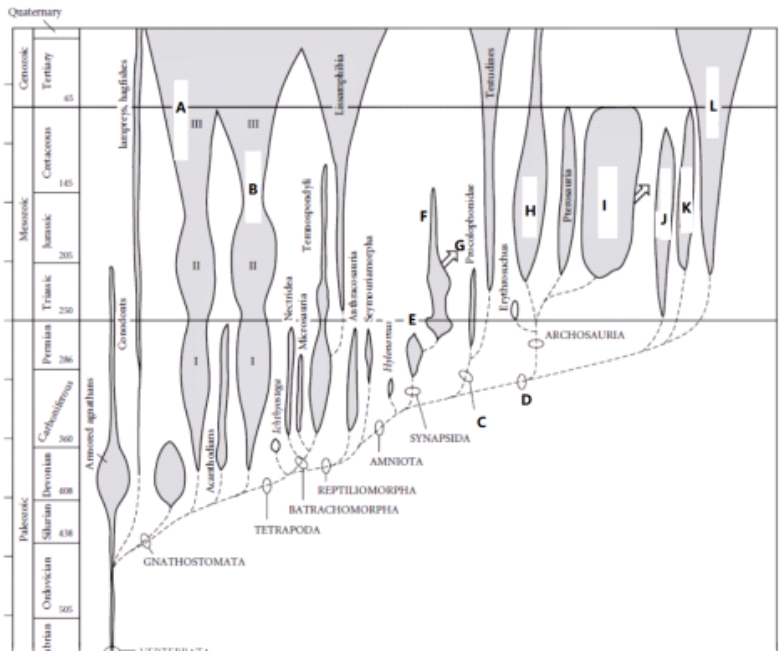
11. When did Z first occur? What's its relationship with C (give its function as well)?

12. Why was C originally incorrectly identified to belong to another group of animal (please give the phylum of this group of animal as well)?

13. What's the essential process that contribute to C's multi-functionaliy? What's the evolutionary importance of this essential process?

Expected Answer: 1. Stromatolites 2. Fusulinids / Nummulites 3. Goniatitida / Ceratitida/ Ammonitida 4 (2 pts). Precambrian; Stromatolites are created by Cyanobacteria (A) 5 (4 pts). Nitrogen fixation; Vegetative, akinetes, heterocyst 6 (2 pts). K-Ar method / Ru-Sr method / Sm-Nd method 7. Cyanotoxin 8 (2 pts). Late Cretaceous (Nummulites), Mid Carboniferous (Fusulinids); B is the projection of X's cell membrane that mainly used for locomotion / ingestion. 9 (2 pts). Reticulopodia; 5 types 10. Limestone 11 (2 pts). Middle Devonian (goniatites), Late Permian (ceratities), Jurassic (ammonites); Aptychus is a soft body part organ that could be used by ammonites (Z) for feeding, protection and locomotion 12 (2 pts). Despite aptychus was often well-preserved, it was usually discovered separated from the ammonites shell so scientists thought it is an anatomical organ of the mollusks. 13 (2 pts). Calcification, it greatly contribute to the diversification of ammonites.

2. (15.00 pts)



1. What type of phylogenetic tree diagram is shown in the above picture?

2. This type of diagram is proposed by whom?

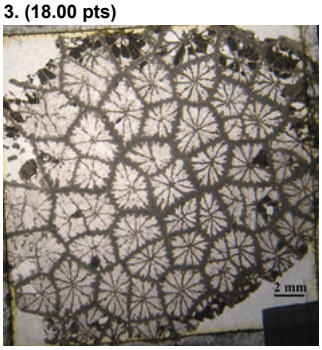
3. What is the biggest disadvantage of this type of phylogenetic tree diagram?

4. Please complete this phylogenetic tree diagram. You are provided a word bank below.

Anapsida	Osteichthyes	Therapsida	Ichthyosauria
Diapsida	Dinosauria	Chondrichthyes	Pelycosauria
Mammalia	Lepidosauria	Plesiosauria	Crocodilia

Expected Answer: 1. Spindile diagram 2. Alfred Romer 3. It complicates the actual relationship of the parent taxon to the daughter taxon 4. A: Chondrichthyes; B: Osteichthyes; C: Anapsida; D: Diapsida; E: Pelycosauria; F: Therapsida; G: Mammalia; H: Crocodilia; I: Dinosauria; J: Ichthyosauria; K: Plesiosauria; L: Lepidosauria

3. (18.00 pts)



(A)

(B)

(C)

1. Identify specimen A.

2. Identify specimen B.

3. Identify specimen C.

4. It is known that A's skeleton is radially symmetric but some of the species closely related with A is bilaterally symmetric. Please explain what cause this difference in body symmetry.

5. Surprisingly, A has the ability to secrete toxin. Which anatomical organ grants A this ability?

6. Scientists speculate that A's venom could contribute to the development of new medicines if A is still alive. Explain why might scientists have such thought on A's venom.

7 (TB 1). A is not a reef builder and its ancestors who lived in Triassic were not reef builders as well. Can we conclude that all of A's concurrent relatives are not reef builder as well? Explain.

8. What's the nickname specific to B?

9. List two important values that B's fossil contribute to the study of paleontology.

10. Describe B's predation defense mechanism.

11. There was an approximately 60 millions years gap in C's fossil record (this means C's fossils are discovered before and after the gap but not during the gap). Describe one distinctive difference in C's fossils before the gap and after the gap.

12. What is the name of the study of fossilized C?

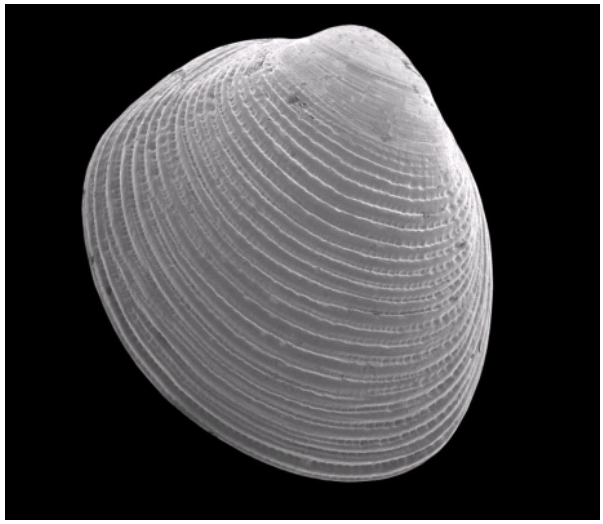
13. The second best preservation sites of C's fossils are locations near the edges of freshwater lakes. Where are they best preserved?

Expected Answer: 1. Sepastrea 2. Crustacea 3. Insecta 4 (2 pts). Bilaterally symmetric corals add their septa in the order of increasing age while radially symmetric corals could align speta with different ages. 5. Cnidocyte 6 (2 pts). A's venom has certain degree of specificity that the toxicity of the venom changes according to the target animals. 7 (2 pts). No because recent researches show that stony corals could have evolve independently within their order and family. 8. Seed shrimp 9 (2 pts). Ostracod fossil is useful in biozonation of the marine strata and it is also an important indicators of ancient marine environment. 10 (2 pts). Bioluminescence --- ostracods emit light from its body to scare the predators away. 11. Insects fossils show wings after the gap but not before. 12. Paleoentomology 13. Amber

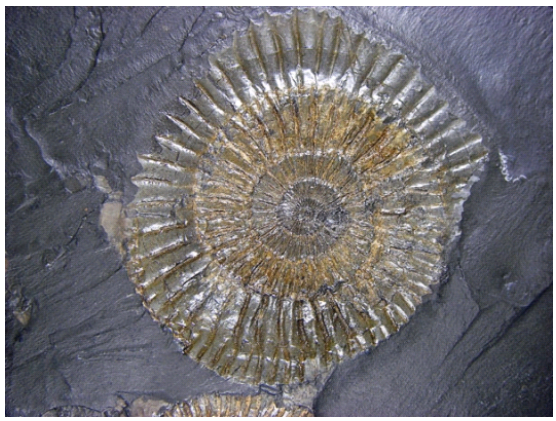
4. (16.00 pts)

(A)

(B)



(C)



(D)

1. Please indicate the mode of feeding of species A, B, C, and D.

2. A used which anatomical organ for food capturing?

3. A's ancestors had developed its crucial feeding organ (the answer you gave in Q2) in which geologic time period?

4. What did B primarily feed on?

5. B attached to its host at which anatomical organ?

6. Scientists consider B as a kleptoparasite. Please list the two requirements that needed to be satisfied by a species in order to be considered as kleptoparasite.

7. The hinge of C's shell lies in which imaginary anatomical plane?

8. C's shell was mainly composed of which biomineral?

9. In order to feed, D primarily used which two anatomical organs?

10. Explain how did D exhibit its sexual dimorphism. What advantage brought by the sexual dimorphism to D?

11 (TB 2). You're likely to find D in which famous lagerstatte?

12. Explain how did D control its shell buoyancy.

Expected Answer: 1. A: filter feeder ; B, C: detritus feeder; D: scavenger 2. Gill 3. Silurian 4. Wastes such as feces excreted by the crinoids 5. Anus 6 (2 pts). First it needs to contai a proboscis, then the host needs to be a suspension feeder 7. Sagittal / longitudinal plane 8. Aragonite 9 (2 pts). Beak; radula 10 (2 pts). Female's shell is bigger than that of the

males. The sexual dimorphism enables the females to have more rooms for egg production. 11. Solnhofen Limestone 12 (2 pts). It used active transport to empty water out of its shel chamber through the siphuncle.

5. (17.00 pts)

1. From a terrestrial tetrapod to an aquatic swimmer, whale had experienced a series of evolution during the Tertiary. Please list two important transition species in the whale evolution.

2. Modern whales are divided into two groups. Please name these two groups of whale and indicate the feature that allow scientists to separate them.

3. During which geologic time period did the two modern whale groups diverge from their common ancestor?

4. What type of skull do whales have?

5. Scientists now determines that modern whales are sexually dimorphic. Which body part of the whales make scientists to make such conclusion and why the significance of this body part is ignored in the past times?

6. Why it is true to state that ancestral horses had experienced an adaptive radiation (you need to be specific here)?

7. What type of tooth do horses have? What is the characteristic of this type of tooth? In addition, list some changes in horse tooth along with the horse evolution.

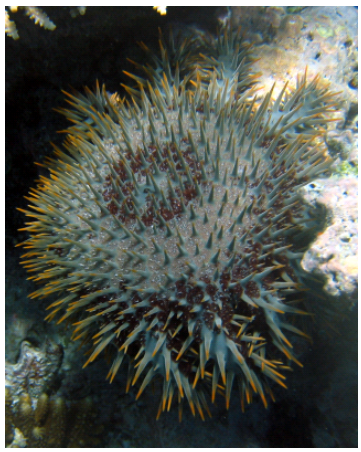
8. Which coat color did all of the ancestral horse have? What cause horses to have a variety of colors nowadays?

9. In 1493, Christopher Columbus had brought horses back to the America continents. Why people describe Columbus brought horses back?

10. The evolutionary sequence of horses, from Eohippus to Equus, was popularized by which English Scientist?

Expected Answer: 1. Pakicetus; Indohyus 2 (3 pts). Baleen whales, toothed whales; Baleen whales don't have real teeth (baleen is not teeth) while toothed whales have teeth 3. Miocene 4. Synapsid 5 (2 pts). Pelvic bone. When whales evolve, their pelvic bones keep getting reduced thus for a long time scientists thought it serve no purpose at all. 6 (2 pts). The amount of ancestral horse quickly rise and diversified after the KT extinction. 7 (3 pts). Heterdont tooth. This means horse have different shaped tooth for different purpose. The tooth become longer and they now have a flatter grinding surface. 8 (2 pts). Dun; Domestication of horses 9. All horses in America went extinct during the Pleistocene extinction even so America continents didn't have a horse until Columbus reintroduce them. 10. Thomas Huxley

6. (17.00 pts)



(A)

(B)

(C)

1. Identify specimen A.

2. Identify specimen B.

3. Identify specimen C.

4. Why is A impossible to live in freshwater habitat?

5. Most of the living A species occur way later than some of the extinct A species. Please indicate when did (geologic time period) the first A species occur.

6. A species greatly diversified in which geologic time period?

7. Viewing the picture of specimen A, you should probably expect this A species is toxic. Which specific toxin is A able to secrete?

8. The appearance of B's feeding apparatus is special. It was first described in which book?

9. Not all of B's species has the special appearance of feeding apparatus addressed in Q8. Give one B species that not has such feeding apparatus and explain the difference.

10. Name the only B genus that had survived through the Permian-Triassic Extinction.

11. Which anatomical organ did C use to attach itself to substrates (Attention: pedicle is wrong in this case because C is a bit different!)?

12 (TB 3). Did C experienced the "Great Dying" event? Explain.

13. Name two predators who doesn't like to prey on C (general name like "horse" is fine).

Expected Answer: 1. Asteroidea 2. Echinoidea 3. Rafinesquina 4 (2 pts). Living in sea water allows starfish to maintain an internal electrolyte balance. Moving to freshwater will break this balance. 5. Silurian 6. Jurassic 7. Asterosaponin 8. History of Animals 9 (3 pts). Heart urchin. Instead of having a tongue-like structure surrounding by five teeth plates,

heart urchin's mouth is surrounded by cilia. 10. Cidaroida 11. pedicle sheath 12 (2 pts). No because Rafinesquina went extinct during the Silurian, way before the "Great Dying" (PT extinction). 13. Fish / Snails (gastropod) / Shrimp (crustacean)

7. (19.00 pts)

(A)

(B)

(C)

1. Identify specimen A.

2. Identify specimen B.

3. Identify specimen C.

4. Now let's call your answer for Q1 (specimen A) as X. Scientists usually divide X into two subgroups. Name these two subgroups and indicate which subgroup is shown in specimen A.

5. Referring to Q4, which X subgroup is still alive today?

6. How did the extinct X subgroup capture foods?

7. Describe two significant tetrapod characteristics of B.

8. B's skull is the closest to which type of skull?

9. Why do scientists classify B as an labyrinthodont?

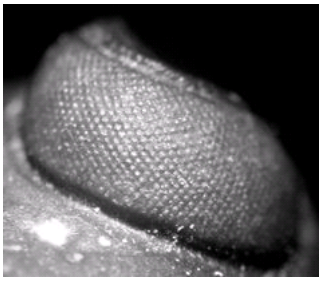
10. Explain why did C accumulate only a tiny amount of mercury inside their body.

11. C was a physostome. What does this mean?

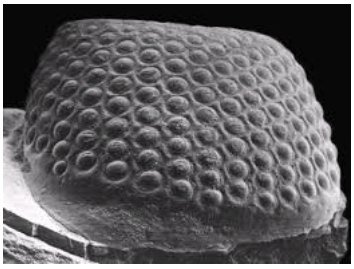
12. What type of scales did B have? What type of scales did C have?

Expected Answer: 1. Agnatha 2. Eusthenopteron 3. Knightia 4 (3 pts). Cyclostome and ostracoderm; specimen A is an ostracoderm. 5. Cyclostome 6 (2 pts). They used their pharynx to create a suction that "attract" the foods into their mouth. 7 (2 pts). First in Eusthenopteron's fin there's a humerus articulating with the glenoid fossa. It also had an internal nostril. 8. Anapsid 9. Its teeth have infolding of enamel so that the cross sections of teeth resembles a labyrinth 10 (2 pts). Knightia is small and it was in the lower trophic level of various marine food webs. 11 (2 pts). Knightia's has a pneumatic duct connecting the gas bladder to its alimentary canal. 12 (2 pts). Eusthenopteron had elasmoid scales while knightia had leptoid scales.

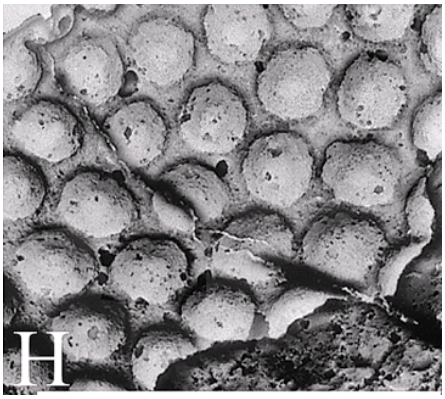
8. (15.00 pts)



(A)



(B)



(C)

The three pictures above depict different types of trilobite eyes. Picture A depicts holochroal eyes, picture B depicts schizochroal eyes, and picture C depicts abathochroal eyes.

1. Approximately, how many lenses are on one holochroal eye? How many lenses are on one schizochroal eye? How many lenses are on one abathochroal eyes?

2. Name the only trilobite order that had abathochroal eyes.

3. Describe the difference between holochroal eyes and schizochroal eyes in terms of adjacent lenses placement.

4. The compound eyes of current arthropods are evolved from which type of eyes?

(D)

5. Name the trilobite anatomical structure depicted in specimen D.

This anatomical structure could be further classified into three types: Natant, Conterminant, and Impendent.

6. From the official fossil list, identify one specific trilobite species for each of the three types.

7. What is the function of trilobite's facial suture?

8. From the official fossil list, identify one specific trilobite species who had an proparian facial suture and one specific trilobite species who had an opisthoparian facial suture.

9. What is the scientific term referring to the "enrollment" of trilobites?

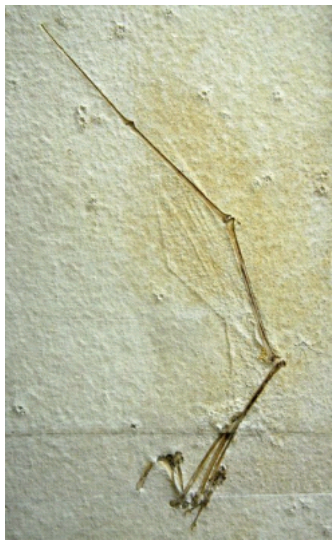
Expected Answer: 1 (3 pts). Holochroal: 15000; Schizochroal: 700; Abathochroal: 70 2. Agnostida 3 (2 pts). Holochroal eyes: adjacent lenses are in direct contact with each other; Schizochroal eyes: adjacent lenses are separated by sclera. 4. Schizochroal eyes 5. Hypostome 6 (3 pts). Natant: Elrathia; Conterminant: Isotelus; Impendent: Eldredgeops 7. Assist trilobites to get rid of its old exoskeleton during ecdysis. 8 (2 pts). Proprian: Eldredgeops; Opisthoparian: Elrathia 9. Volvation

9. (24.00 pts)

(A)

(B)

(C)



(D)

(E)

(F)

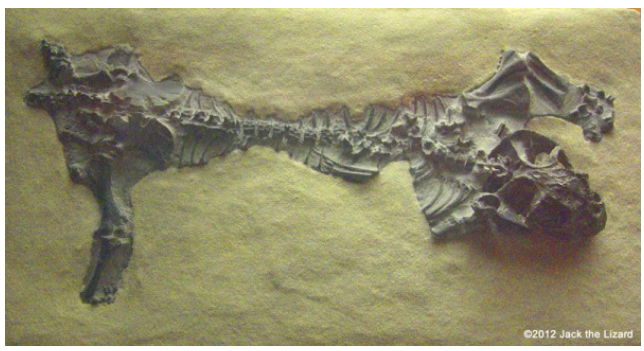
(G)

(H)

(I)

(J)

(K)



(L)

Fill out the table below by identifying each specimen and indicate they are first discovered in which country (there was one species that scientists don't know where its first fossil was exactly discovered, write "uncertain" for that species).

Specimens	Identification	First Discovered Country
A		
B		
C		
D		
E		
F		
G		
H		
I		

Specimens	Identification	First Discovered Country
J		
K		
L		

Expected Answer: A: Xiphactinus; USA B: Crocodilia; Uncertain C: Ichthyosauria; UK D: Pterosauria; Germany E: Plesiosauria; UK F: Ankylosaurus; USA G: Protoceratops; China H: Stegosaurus; USA I: Iguanodon; UK J: Plateosaurus; Germany K: Diplodocus; USA L: Lystrosaurus; South Africa

10. (20.00 pts)

1. Please fill out the table which contains some general radioactive decay information below (Your answer should be in the format like this: 1. Alpha: answer, answer).

Radioactive Decay Types	Change in Atomic Number	Change in Mass Number
Alpha		
Beta		
Gamma		
Positron Emission		
Electron Capture		

2. When trying to date the age of discovered fossils, scientists prefer to use alpha type radioactive dating methods (U-Pb dating i.e.) instead of beta type and gamma type. Explain why scientists have such a preference.

3. Please fill out the table below based upon given information (Your answer should be in the format like this: 3. Tl-207: answer).

Nuclide	Daughter Product	Mode of Decay
Tl-207	Pb-207	
Ne-19		Positron Emission
Se-75		Electron Capture
Np-237		Alpha

4. A meteor has a Pb-206:U-238 mass ratio of 0.78 : 1.00. What is the age of the meteor?

Expected Answer: 1. Alpha: -2, -4; Beta: +1, unchanged; Gamma: both unchanged; Positron: -1, unchanged; Electron capture: -1, unchanged 2 (2 pts). Despite an alpha particle could emit way more energy than a beta or gamma particle, its penetration power is low thus exposing alpha particles outside of human body is relatively safe. 3. Tl-207: Beta; Ne-19 F-19; Se-75: As-75; Np-237: Pa-233 4 (4 pts). k = ln(2) / (U-238 half life) k = 1.54*10^(-10) 0.78 / 206 * 238 = 0.901 g U-238 ln (m / m0) = -kt ln (1/(1+0.901)) = -kt t = 4.17*10^9 years

11. (18.00 pts)

(A)

(B)

(C)

1. Identify specimen A.
2. Identify specimen B.
3. Identify specimen C.
4. What type of plant (photosynthetic) did A eat?
5. What pattern of dentition did A have? How is this pattern of dentition match with A's mode of life and diet?
6. List three speculations on the cause of A's extinction (*** You won't get partial credits on this question).
7. Why did scientists speculate that B might have feathers? Why most of the discovered B fossils don't show the clue that they were once feathered?
8. Explain how did scientists research whether B had the ability to regulate its body temperature.
9. Name the parasite that lived in B's body. What's the effect of having this parasite on B?
10. The most complete B fossil skeleton was discovered in which U.S. state and in which year?
11. Specimen C is a trace fossil. Based upon the Seilacherian system of trace fossil classification, what type of trace fossil is C?
12. Which bone of C suggests that it communicated by roaring?
13. Describe why 3 years of age is important to C.

Expected Answer: 1. Mammuthus 2. Tyrannosaurus 3. Smilodon 4. C3 plants 5 (2 pts). Mammoth had hypsodont molar teeth. Hypsodont teeth have mostly flat surfaces so they really helped mammoth to crush and grind grass. 6 (1 pt). Overhunting; climate change; disease infection. 7 (2 pts). The filamentous structure was discovered in some of the smaller tyrannosaurus species. Most of the discovered tyrannosaurus fossils are large species so they might lose their feather because of having a smaller surface to volume ratio. 8 (2 pts). They calculate ratios of oxygen isotope in different body part of B to examine whether there's a significant difference between two body parts that don't locate too close to each other (head vs leg i.e.). 9 (2 pts). Trichomonas. It cause the formation of some small smooth-edged holes on tyrannosaurus's skull 10 (2 pts). 1990, Montana 11. Repichnia 12. Hyoid bone 13. Smilodons' saber teeth will reach full size at 3 years of age.

12. (17.00 pts)

(A)

(B)

(C)

1. Identify specimen A.

2. Identify specimen B.

3. Identify specimen C.

4. A's appearance is barely changed since Cretaceous. What is the term describing this phenomenon?

5. A contains which class of organic chemical compound that promotes A's survivability and medical use value?

6. A could generate two different types of spores as a part of pre-reproduction preparation. Please name the two types of spores and specify which type belongs to male and which type belongs to female.

7. How long is one reproductive cycle of A?

8. Beside experiencing a color change, B leaves are also spotted during certain seasons in a year. Which fungus species causes the formation of these spots on B leaves?

9. B is an angiosperm. This type of plants experienced a great adaptive radiation during which geologic time period?

10. What's an outstanding reproductive feature of B as an angiosperm?

11. Describe the one angiospermous feature and one gymnospermous feature of C.

12. Describe the difference in leaf appearance between the extant C and extinct C.

13. Scientists speculate that C's morphology has barely changed over hundreds millions of years. Propose a research direction that scientists would dig in-depth in order to find some concrete evidence to support their long-time speculation.

Expected Answer: 1. Metasequioa 2. Acer 3. Ginkgo 4. Morphological stasis 5. Phenol 6 (4 pts). Microspore (male); megaspore(female) 7. 2 years 8. Rhytisma 9. Cretaceous 10. It flowers to attract pollinators. 11 (2 pts). Ginkgo's pollen organs are similar to catkins which are angiospermous. Ginkgo's seeds are not protected by an ovary wall which makes it gymnospermous. 12. The leaves of extinct Ginkgo were more dissected. 13. Compare and contrast the reproductive structure of the extant ginkgo and extinct ginkgo.